Space Weather Technical Forecast

Issued on Friday, 22 April 2022 at 01:32 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance X-flares (R3 Radio Blackouts), with further M-class flares (R1/R2 Radio Blackouts) likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity is currently Moderate with an M9.6 flare observed from AR2993 peaking 21/0159 UTC. Since then activity has subsided, however, a C7 flare was observed from AR2994 peaking 21/2104 UTC. Background flux is around C1 levels, with five sunspot regions currently on the Earth-facing disc. AR2993 Eki/Beta-gamma and AR2994 Ehi/Beta form a large complex of sunspots in the northeast disc, and despite some indication of decay in AR2994, these areas form the main source of the ongoing activity. AR2995 Cho/Beta in the northeast is moderately sized, but magnetically simple, as is AR2996 Cao/Beta in the far northeast. AR2991 Cri/Beta in the southwest has shown signs of slow development, but remains largely inactive for now. A further sunspot group appears to be rotating over the northeastern limb, but is too foreshortened in available imagery to make an accurate assessment at present. A CME was observed leaving the Sun due to the M9.6 flare, however imagery for analysis has been limited. Current indications are that this is a weak CME, with a glancing arrival possible late on the 24th.

Solar Wind / Geomagnetic Activity: The solar wind speed as measured by ACE and DSCOVR at L1, has been slightly elevated, initially starting the period at around 400km/s, but increasing to around 470km/s. The density was mainly average, with brief deviations to above and below average at times through the period. A peak value of around 24ppcc was observed at 21/1544 UTC. The magnitude of the Interplanetary Magnetic Field (IMF), Bt, was mostly weak below 8nT, with its north-south component, Bz, varying between +7/-6 nT. However Moderate IMF arrived just after 21/1100 UTC with Bz becoming southward at -8nT, along with density falling to background. Solar winds also started to slowly rise. This was potentially the arrival of the fast wind of CH76, a coronal hole that is no longer apparent on the disc. The phi angle was generally positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was at Background levels throughout. The high energy electron flux (greater than 2MeV) has been at normal background to Moderate levels during the period, with a maximum of 194 pfu recorded at 21/2010 UTC. The corresponding 24-hour integrated electron fluence showed a steady, then sharp declining trend, remaining below the Active threshold throughout. This reached a value of 7.68e6 integrated pfu at 21/2100 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Moderate over the next four days, with a chance of X-class flares (R3 Radio Blackouts), mainly from the large region in the northeast quadrant. There is on ongoing likelihood of isolated M-flares (R1/R2 Radio Blackouts).

Solar Wind / Geomagnetic Activity: The CME from the M9.6 flare on the 21st has the potential to glance Earth on the 23th (Day 3). Solar winds are expected to be at slightly elevated speeds on Day 1 (22nd) due to the influence of CH76. Winds should then ease to background levels again on Day 2 or 3 (23rd or 24th) ahead of the next possible coronal hole enhancement on Day 3 or 4 (24th or 25th) from CH77. Geomagnetic activity is likely to be Quiet with isolated Unsettled

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intervals, and a slight chance of Active intervals each day. Activity probably increasing to Unsettled to Active on Day 3 or perhaps Day 4 (25th) with a chance of G1/Minor storms due to the arrival of the high-speed stream of CH77 and/or any CME glance that occurs, although this carries low-moderate confidence.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels, although there is a very gradually increasing risk as the more complex regions on the earth-facing disc rotate westward. The high energy electron flux (greater than 2 MeV) is expected to be at mainly background levels. Any periods of Moderate flux should generally be limited to diurnal maximums. The associated 24 hr electron fluence is forecast to be below the Active threshold (1e8 total pfu) throughout the period.

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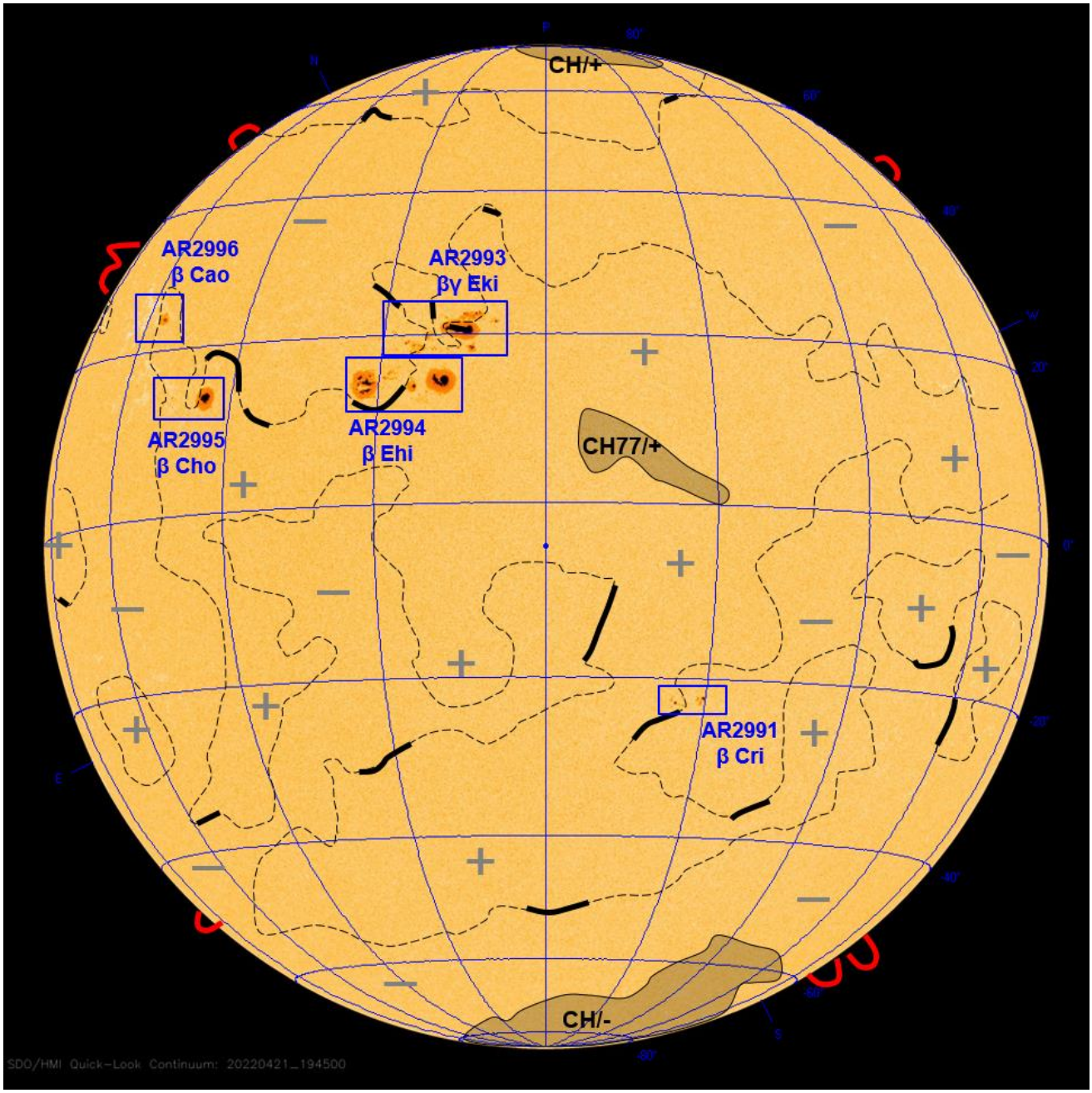
Figure 1. Solar Analysis Valid 21/1945 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The CME from the M9.6 flare on the 21st has been assessed as likely passing to the north and behind Earth, but with a chance of a glancing interaction late on Day 3 (24th). Otherwise, no earth-directed CMEs currently feature in the forecast period.

Solar winds are expected to be at slightly enhanced speeds on Day 1 (22nd) due to the influence of CH76, which was present when in the centre disc. STEREO A encountered a similar solar wind regime in previous days, so slightly elevated speeds could also be maintained into Day 2 (23rd) before likely easing to background speeds again thereafter. CH77 is the next feature of note, but is much reduced in apparent size and has retreated eastwards compared to the previous rotation. As such is not expected to arrive until later on Day 3 (24th).

Geomagnetic activity is likely to be Quiet with isolated Unsettled intervals, and a slight chance of Active intervals each day. Activity probably increasing to Unsettled to Active on Day 3 or perhaps Day 4 (25th) with a chance of G1/Minor storms due to the arrival of the high-speed stream of CH77 and/or any CME glance that occurs, although this carries low-moderate confidence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	30	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
21/1429	Partial	M9.6 flare	16N 19E (AR2993)	320 km/s	25/0000 UTC	Low-moderate confidence of a glancing impact

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Radio Blackouts - X-Ray Flares:

There are currently five sunspots on the visible disc. AR2993 (Eki/Beta-gamma) and AR2994 (Ehi/Beta-gamma) form a complex of two magnetically interacting features, and appears to be the main source of significant flare risk. AR2993 appears similar with occasional proliferation of spots in the trailer portion of the group. AR2994 looks to be decaying slightly with the large trailer spot less well defined in recent hours. These two regions are followed by a couple of smaller, and simpler spots although these still present a slight flare risk. Elsewhere on the disc, AR2991 (Cri/Beta) is a reemerged spot, but slightly displaced. This region appears to be developing slightly with evidence of penumbra trying to form on the trailer portion of the group. A further sunspot group appears to be rotating over the northeastern limb, but is too foreshortened in available imagery to make an accurate assessment at present.

STEREO-A EUVI imagery suggests further bright areas of flux that may contain sunspot regions that are expected to rotate onto the earth-facing disc in the coming days. This may provide further opportunity for significant flares to occur.

Moderate activity is likely to continue through the period, with a daily slight chance of increasing to Strong due to the occurrence of any X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 2: GOES16/17 X-ray flux

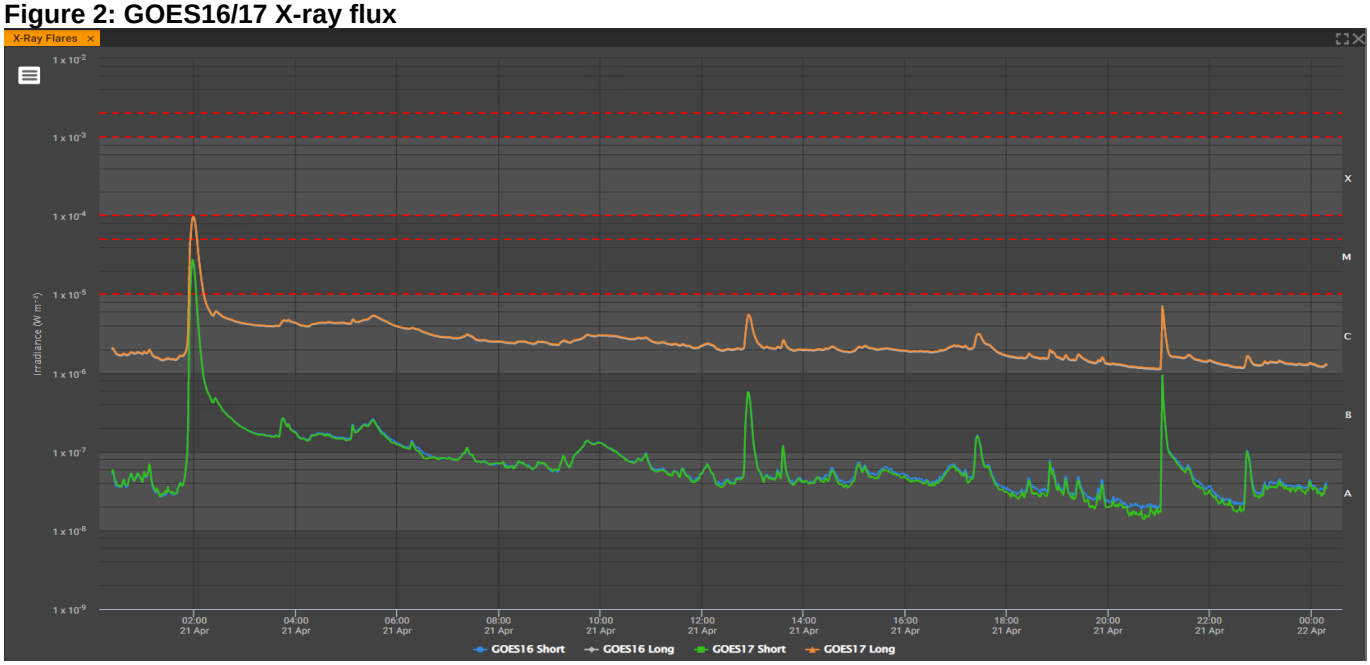

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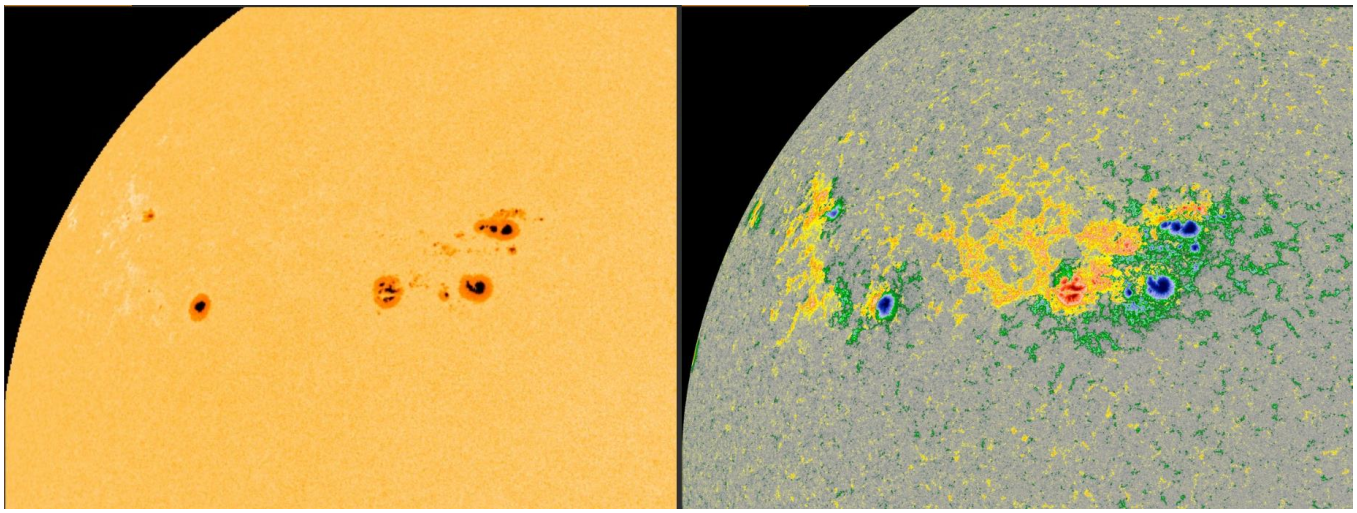
Figure 3: SDO Magnetogram and intensitygram of NE disc at 21/2345 UTC.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days.

AR2993 and AR2994 form a complex of sunspots across the northeast disc that is gradually rotating into a more geoeffective position for proton enhancement. Any notable flares from these regions have a slight, but increasing potential for proton storms to occur at Earth through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	7	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 is expected to be at mainly background levels. Any periods of Moderate flux should generally be limited to diurnal maximums. The High alert threshold (1000 pfu) is not expected to be reached.

The associated 24 hr electron fluence is forecast to be below the Active threshold (1e8 total pfu) throughout the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: GOE-6 >2MeV Electron Flux and associated fluence with REFM

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